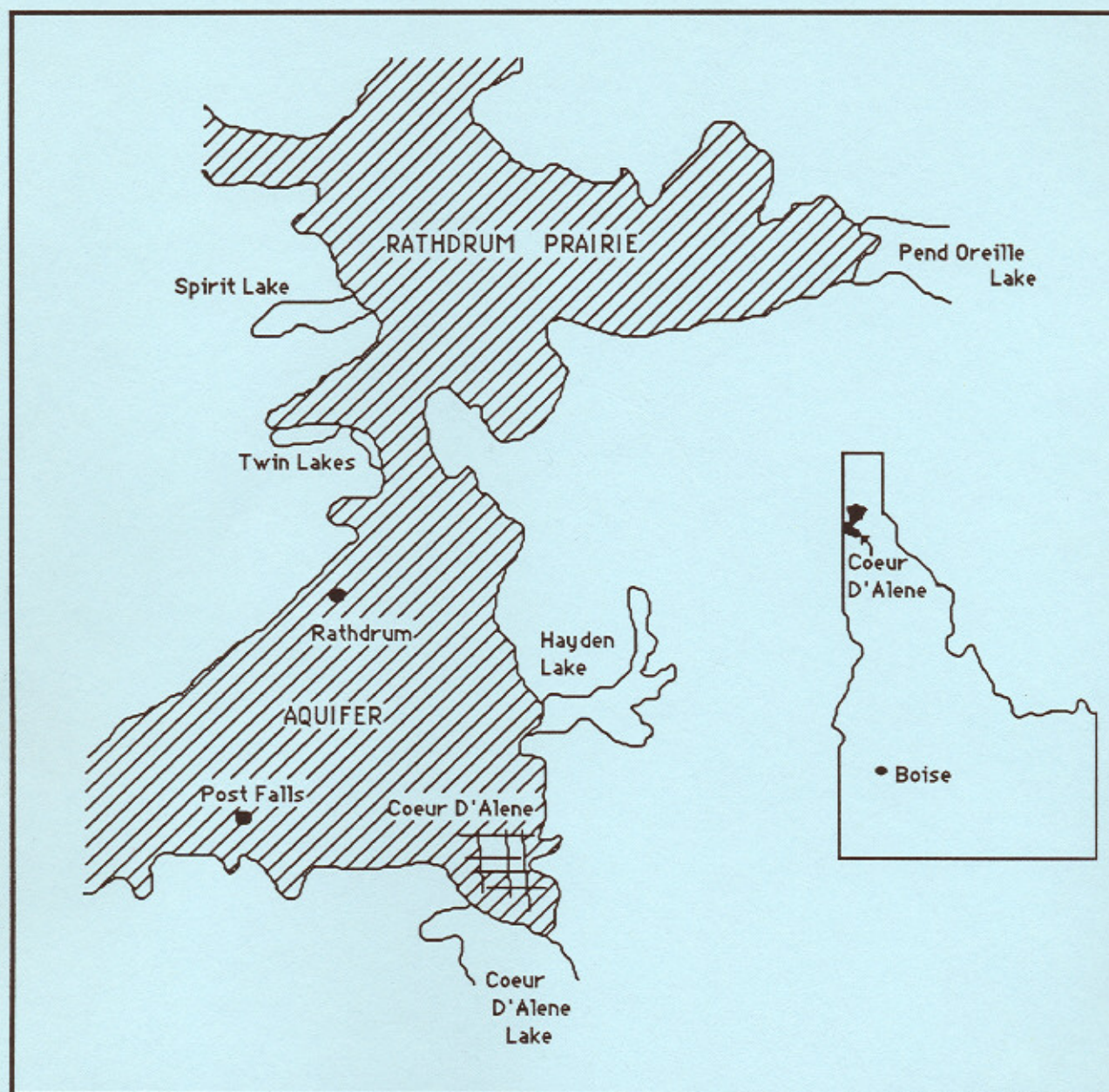


THE RATHDRUM PRAIRIE AQUIFER TECHNICAL REPORT



IDAHO DEPARTMENT OF HEALTH AND WELFARE
DIVISION OF ENVIRONMENTAL QUALITY
BUREAU OF WATER QUALITY

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TECHNICAL REPORT

PREPARED BY:

PAUL JEHN
IDAHO DEPARTMENT OF HEALTH AND WELFARE
DIVISION OF ENVIRONMENTAL QUALITY
BUREAU OF WATER QUALITY
450 WEST STATE STREET
BOISE, ID 83720-9990

IN COOPERATION WITH:

KENNETH W. LUSTIG AND TONY DAVIS
PANHANDLE HEALTH DISTRICT 1
COEUR D'ALENE, ID 83814

AND

IDAHO DEPARTMENT OF WATER RESOURCES

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ABSTRACT

The Rathdrum Prairie Aquifer lies in a valley filled with glacial outwash deposits generated during flooding from glacial Lake Missoula. Designated in 1978 as a sole source aquifer by the Environmental Protection Agency, this aquifer supplies drinking water to over 55,000 people in Idaho. In Washington, nearly 250,000 people obtain drinking water from groundwater which flows through the Rathdrum Prairie Aquifer.

Geohydrologic analysis of the Rathdrum Prairie Aquifer indicates high porosities, permeabilities and transmissivities. Groundwater flow, calculated in some places to be in excess of 50 feet/day, is generally from northeast, near Spirit and Pend Oreille Lakes, Idaho, to southwest, discharging into the Spokane River near Spokane, Washington. Recharge from tributary valleys in Idaho is the main contributor of recharge to the aquifer with lesser amounts coming from seepage from the Spokane River and precipitation.

Soils developed over the Rathdrum Prairie Aquifer are well drained to excessively well drained. The absence of major restrictive layers in the unsaturated zone results in high potential for contamination from surface activities. Water quality testing has linked nitrate contamination of the aquifer with high usage of subsurface sewage disposal systems.

Analysis of activity on the Rathdrum Prairie identified fourteen potential sources of groundwater contamination. Of these sources, agricultural activities, petroleum, surface runoff/drainwells, landfills, septic tanks and hazardous materials have been identified as having the highest pollution potential.

Prevention of contamination is viewed as the best possible method of managing the water quality of the Rathdrum Prairie Aquifer. Ambient water quality of the aquifer appears to be good at this time. The increased land use activities on the Rathdrum Prairie combined with the aquifer's susceptibility to contamination indicate that judicious management of this sole source of drinking water is imperative.

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Chapter 1. Introduction

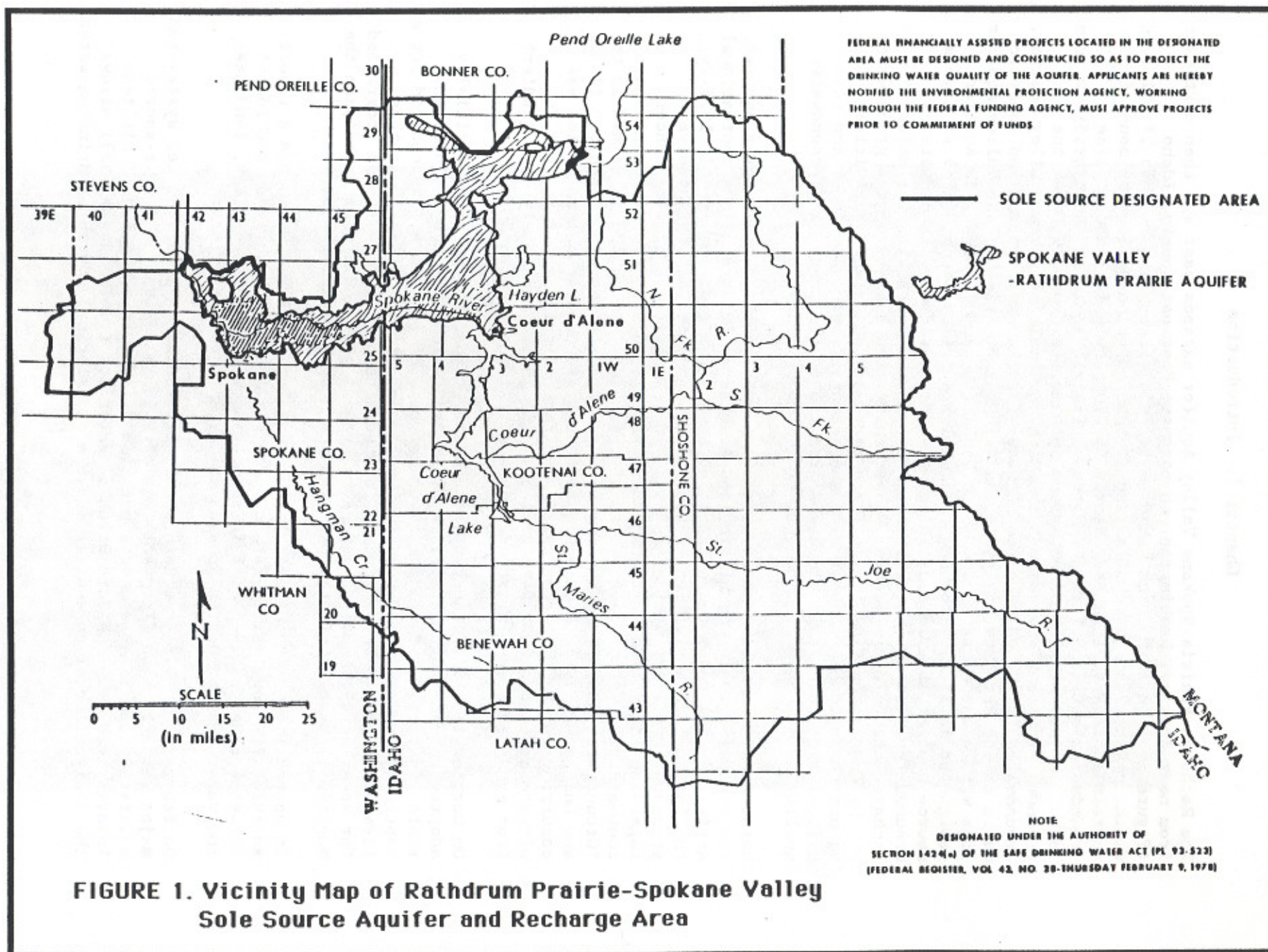
The Rathdrum Prairie-Spokane Valley Aquifer extends east and then northeast from near Spokane, Washington, to northern Kootenai County, Idaho (Figure 1). In Idaho, the Rathdrum Prairie varies from five to 17 miles in width, covers 283 square miles and is bounded on both sides by mountainous terrain and numerous lakes. Nearly 55,000 people in Idaho utilize groundwater obtained from the Rathdrum Prairie Aquifer. Down-gradient from Idaho, 250,000 people in and around Spokane are dependent upon the groundwater that flows through the Rathdrum Prairie-Spokane Valley Aquifer. Groundwater is the main source of water for the agricultural and domestic users on the Rathdrum Prairie. The Rathdrum Prairie-Spokane Valley Aquifer lies within the boundaries of both Washington and Idaho. This aquifer, designated in 1978 by the Environmental Protection Agency (EPA) as a sole source aquifer, provides drinking water for residents of both states. Groundwater flow is generally northeast to southwest with the major recharge occurring in Idaho. Consequently, the quality of the groundwater on the Washington side is, in large part, dependent upon activities occurring in Idaho. Cooperative management practices by local and state officials of both Idaho and Washington are crucial regarding groundwater quality.

Water quality has long been a concern. Over the Rathdrum Prairie Aquifer, the steadily growing population and associated industrial and recreational activities all point to an increased demand for groundwater. In 1975-76, the Panhandle District Health Department conducted a comprehensive groundwater quality monitoring study in response to a growing concern regarding activities on the Rathdrum Prairie in relation to groundwater contamination. From the results of this study, which are contained in the "Groundwater Quality Monitoring Rathdrum Prairie Technical Report," (Jones and Lustig, 1977) it became apparent that groundwater contamination was occurring in the Rathdrum Prairie Aquifer. Significant increases in nitrate concentrations were detected beneath or immediately down gradient from areas experiencing rapid suburban residential growth.

On October 11, 1977, the Panhandle District Health Department officially adopted the "Rathdrum Prairie Aquifer Regulations." These regulations state, in part, that (1) a minimum lot size of five acres is required for a septic system and (2) development would be allowed on lots less than five acres provided the land is located within a municipal area programmed for sewer service under a sewage management plan and agreement between the municipality and the Panhandle District Health Department.

In cooperation with the EPA, the U.S. Geological Survey prepared a report entitled "Spokane Valley-Rathdrum Prairie Aquifer, Washington and Idaho" (Drost and Seitz, 1978). This report summarizes the hydrology, land use and water quality of the Spokane Valley-Rathdrum Prairie area.

On February 7, 1978, the Rathdrum Prairie-Spokane Valley Aquifer system and major recharge area (Figure 1) was officially designated a sole-source aquifer by the EPA based on a petition filed by a coalition of citizens' interest groups. The Safe Drinking Water Act (Public Law 93-523) allow the designation of an aquifer as sole or principal source of drinking water



**FIGURE 1. Vicinity Map of Rathdrum Prairie-Spokane Valley
Sole Source Aquifer and Recharge Area**

if it is determined that, by contamination, it would create a significant public health hazard. Designation of an aquifer as sole source gives the EPA review authority to help ensure that federally assisted or guaranteed projects are planned and designed to ensure that they will not contaminate the aquifer.

EPA considers the recharge zone a major factor in protecting the Spokane Valley-Rathdrum Prairie Aquifer system.

"The drainage divide of the Spokane River-Coeur d'Alene Lake basin, approximately 5,000 square miles, is the prime area of recharge for the aquifer and, therefore, included in the area to be designated as sole source. Within this basin, the aquifer boundaries and recharge area have been delineated. Numerous lakes and streams provide the major recharge to the aquifer with some recharge occurring from precipitation on the recharge area. Figure 1 is an enlarged base map showing the Spokane Valley-Rathdrum Prairie Aquifer and its recharge and drainage area subject to sole-source designation. This chart should be used in conjunction with descriptive language when determining whether a federally financially assisted project is located in the designated area and therefore subject to EPA review under Section 1424E of the Safe Drinking Water Act" (Jorling and Dubois, 1977).

In September 1978, the Water Quality Management Plan for the Rathdrum Prairie Aquifer was developed under Section 208 of the Clean Water Act. Results of the 208 study indicate that water quality of the aquifer is tied to human activity over it (Jones and Lustig, 1977). In 1979, Whitehead and Parlman ranked the Rathdrum Prairie Aquifer third in pollution potential from a list of 84 hydrologic units in Idaho.

The State Groundwater Management Plan (Martin, 1983, updated 1985) identified the Rathdrum Prairie Aquifer as having a high pollution potential due to the extensive population growth which has occurred in the area and the highly porous nature of the aquifer. The Rathdrum Prairie Aquifer is designated a special resource under Idaho's Water Quality Standards. This important aquifer is managed jointly by the Department of Health and Welfare and the Panhandle Health District. Protection against degradation is currently provided by the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDHW, 1985d) and the Panhandle Health District, Rathdrum Aquifer Subsurface Sewage Regulations. Groundwater quality monitoring is performed quarterly by the Panhandle Health District in cooperation with the Spokane 208 office.

The primary purpose of this report is to summarize the existing data with regard to the hydrology and land use patterns of the Rathdrum Prairie Aquifer and identify the major potential contaminant sources. By applying a rating and ranking system to these potential sources of contamination, they can be prioritized according to pollution potential. This rating of potential contaminant sources then forms the basis for strategy development for aquifer protection.

Chapter 2. Geology

The Rathdrum Prairie-Spokane Valley Aquifer system, which extends from Pend Orielle Lake, Idaho, to Long Lake, Washington, occupies a glacially scoured trough formed when continental glaciers extended down the Purcell Trench during the Pleistocene epoch. Fluvioglacial deposits form the aquifer material and are composed of poorly to moderately sorted sand and gravel. Fine sand and silt are rare except within the upper three to five feet. Minor clay lenses do occur, scattered throughout the deposit.

The dominant physiographic feature of the area is the Purcell Trench, a broad structural and erosional trough that extends down southward from Canada to Coeur d'Alene, thence westward toward Spokane. This trough has both glacial and fluvioglacial deposits, which are generally highly permeable and have a high storage capacity. The surface of the valley fill south of Athol is known as the Rathdrum Prairie in Idaho and as the Spokane Valley in Washington. The surface slopes southwesterly from an elevation of 2,450 feet at Athol to 1,900 feet at Spokane (Frink, 1968).

The trench is bordered by mountains, rising to an elevation of 5,000 feet in places, composed of sedimentary, metamorphic, and volcanic rocks ranging in age from Precambrian to Tertiary (Figure 2). These rocks, for the most part, are nonwater bearing and thus form the walls and floor of the groundwater reservoir.

Precambrian metamorphosed sediments with quartz diorite intrusives compose most of the Coeur d'Alene and Cabinet Mountains east of the Purcell Trench. Mesozoic granite and gneiss comprise the Selkirk Mountains west of the trench and higher mountains west of Coeur d'Alene. The Columbia River basalts were extruded in Tertiary time. These are very extensive south and west of Spokane. At one time these flows extended far up the Purcell Trench, but now most of the flows have been removed by erosion and only a few remnants are found along the valley sides in Idaho near Coeur d'Alene and north of Hayden Lake (Frink, 1968).

The geologic history since the beginning of Tertiary time is significant from the standpoint of groundwater occurrence. In pre-Miocene time, the drainage from a large area to the north and east was southward from the Purcell Trench and Clark Fork Valley through the Rathdrum Prairie and then westward through the Spokane Valley to the ancient Columbia River. The eastward advance of basalt flows near Spokane formed a lake in this drainage in which as much as 1,500 feet of clays and silts, called the Latah formation, were deposited before being covered by younger basalt flows. As a result of this blockage near Spokane, the entire drainage system was reversed to flow northward through the Purcell Trench into Canada. Subsequent erosion, prior to the first ice advance, removed much of the basalt and Latah clays from the Rathdrum Prairie-Spokane Valley area. Walker, 1964, provided the following summary of the glacial history of the area:

During the first recognized stage of glaciation in this region - - the Spokane advance - - ice moved southward in the lowlands as far as the site of Coeur d'Alene. The valleys probably were deepened

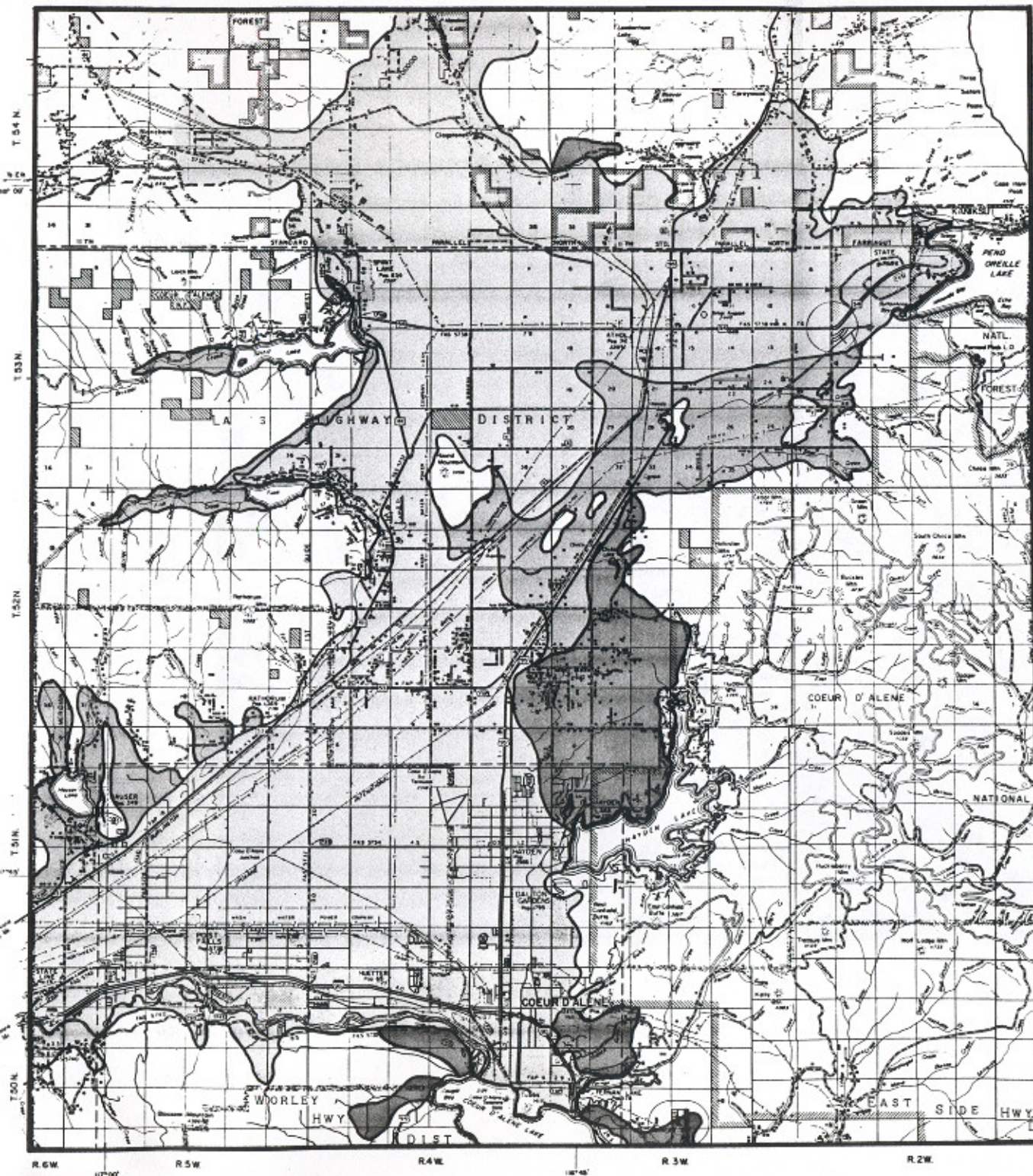





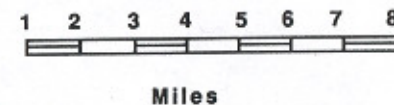


FIGURE 2. Geologic Map of Kootenai County

Explanation

-  Rathdrum Prairie Aquifer
-  Tertiary & Quaternary Alluvium and Glacial Outwash Deposits
-  Other Deposits of Tertiary and Quaternary Alluvium and Glacial Outwash
-  Miocene Basalt
-  Cretaceous - Precambrian Granites and Metamorphic Belt Complex

Base Map: General Highway Map Of Kootenai County
Geology Modified From Anderson, 1940



considerably during this stage. The ice probably was 5,000 feet thick above the bedrock floor of the trough of Pend Oreille Lake and overtopped all but a few of the higher mountains. The ice moved up the valley of Clark Fork for several miles and impounded Lake Missoula, whose surface rose to an altitude of about 4,200 feet. The lake was as much as 2,000 feet deep above the ice dam and had a total area of about 3,300 square miles (Alden, 1953, p. 155). The recognizable deposits of this ice are the moraines or accumulations of till, now much weathered and eroded, near Coeur d'Alene.

Fluvioglacial deposits, principally outwash, filled the Spokane Valley, Rathdrum Prairie and Hoodoo Valley to unknown depths (probably 500 feet or more in many places). These deposits dammed side drainages to form Hayden, Coeur d'Alene, Liberty, Newman, Hauser, Twin and Spirit Lakes. Of these lakes, only Coeur d'Alene has a perennial surface outlet (Anderson, 1927).

After retreat of this first ice sheet, the Clark Fork River was blocked by the glacial fill in the upper Rathdrum Prairie, and it occupied a new course westward from Sandpoint along the present Pend Oreille River channel.

During the Wisconsin Glaciation, the ice came down the Purcell Trench from Canada and left a terminal moraine near Athol at the south end of Pend Oreille Lake. This ice lobe cleared earlier gravels from the Purcell Trench at Pend Oreille Lake and possibly excavated some Latah clays to form a deep, U-shaped trough now occupied by the lake. The lake is more than 1,100 feet deep in places, according to the Coast and Geodetic Survey. This ice advance extended up the Clark Fork creating glacial Lake Missoula. Meltwater from Lake Missoula spread great masses of gravel out onto the Rathdrum Prairie and Spokane Valley.

Field evidence firmly establishes that the Rathdrum Prairie was the site of periodic colossal jökulhaups (glacier outburst floods) (Waitt, 1985). Numerous great floods fanned across the Rathdrum Valley from the margin of the continental glacier, depositing well-washed sands and gravels in their wake. These sands and gravels all have high porosities and permeabilities and form the material for the Spokane Valley-Rathdrum Prairie Aquifer and overlying unsaturated zone.